

### IN THE TITLE:

Please amend the Title of the Application to as follows:

“Spatial Separation and Multi-Polarization of Antennae in a Wireless Cellular Network”

### IN THE DRAWINGS

Please amend Figures 1 and 9 in accordance with the marked-up drawing sheets attached hereto.

### IN THE SPECIFICATION

Please amend the specification as follows:

- Please amend the paragraph beginning at line 16 on page 19 as follows:

Figure 6a is a plot of the singular values (averaged across small scale fades) versus time for the system of Figure 4 that includes spatially separate antennae having the same polarization states and a K-factor of 6 dB. The system of Figure 4 includes two transmitter antennae and three receiver antennae.

Therefore the channel matrix H has two singular values. The first singular value 605 has an average value of about 7.5 dB relative to a normalized reference. The second singular value 610 has an average value of about -12.5 dB. Therefore, the resulting singular value spread is about  $7.5 + 12.5 = 20$  dB.

- Please amend the paragraph beginning at line 3 of page 20 as follows:

Figure 6b is a plot of the singular values versus time for the system of Figure 5 that includes spatially separate antennae having the different polarization states and a K-factor of 6 dB. Again, the channel matrix H has two singular

values. The first singular value 615 has an average value of about 5 dB. The second singular value 620 has an average value of about -5 dB. Therefore, the resulting singular value spread is about  $5 + 5 = 10$  dB. The system of Figure 5 provides a singular value spread that is 10 dB less than the singular value spread of the system of Figure 4, and therefore, has a better noise enhancement performance.

- Please amend the paragraph beginning with line 11 of page 20 as follows:

Figure 6c is a plot that shows the capacity of the systems of Figure 4 and Figure 5 with a K-factor of 6 dB. As shown in Figure 6c, the capacity of the system of Figure 5 (denoted with line 635) is greater than the capacity of the system of Figure 4 (line 630). The probability axis indicates the probability that a receiver can receive information at the specified capacity or less. The capacity axis indicates the capacity of the channel for the specified antenna polarization settings.

- Please amend the paragraph beginning with line 17 of page 20 as follows:

Figure 7a is a plot of the singular values versus time for the system of Figure 4 that includes spatially separate antennae having the same polarization states and a K-factor of 10 dB. Again, the channel matrix H has two singular values. The first singular value 705 has an average value of about 7.5 dB relative to a normalized reference. The second singular value 710 has an average value of about -15 dB. Therefore, the resulting singular value spread is about  $7.5 + 12.5 = 22.5$  dB.

- Please amend the paragraph beginning at line 1 of page 21 as follows

Figure 7b is a plot of the singular values versus time for the system of Figure 5 that includes spatially separate antennae having the different polarization states and a K-factor of 10 dB. Again, the channel matrix H has two singular values. The first singular value 715 has an average value of about 4 dB. The second singular value 720 has an average value of about -4 dB. Therefore, the resulting singular value spread is about  $5 + 5 = 8$  dB. The system of Figure 5 provides a singular value spread that is 14.5 dB less than the singular value spread of the system of Figure 4.

- Please amend the paragraph beginning with line 8 of page 21 as follows:

Figure 7c is a plot that shows the capacity of the systems of Figure 4 and Figure 5 with a K-factor of 6 10 dB. As shown in Figure 7c, the capacity of the system of Figure 5 (denoted with line 735) is greater than the capacity of the system of Figure 4 (line 730). The probability axis indicates the probability that a receiver can receive information at the specified capacity or less. The capacity axis indicates the capacity of the channel for the specified antenna polarization settings.

#### PENDING CLAIMS:

The currently pending claims, as originally filed, are provided as follows:

- 1    1. (Currently Amended)      A wireless communication system comprising:
  - 2            a plurality of spatially separate transceiver antennae to transmit a corresponding
  - 3            plurality of data streams comprising a communication channel to a remote receiver
  - 4            having a plurality of receiver antennae, each transceiver spatially separate from at least
  - 5            one other transceiver antenna, each transceiver antenna further comprising a transceiver

6 antenna polarization, at least one transceiver antenna having a polarization that is  
7 different than at least one other transceiver antenna, ~~each transceiver antenna transmitting~~  
8 ~~a corresponding data stream;~~

9 ~~a plurality of receiver antennae, the receiver antennae receiving at least one data~~  
10 ~~stream;~~ wherein

11 the communication channel between the transceiver antennae and the receiver  
12 antennae is characterized by a channel matrix, and wherein the transceiver antenna  
13 polarization of each transceiver antenna is ~~pre-set to optimize determined by reducing a~~  
14 measure of a singular value spread of the channel matrix to improve a separability of the  
15 received data streams.

1 2. (Currently Amended) The wireless communication system of claim 1, wherein  
2 the ~~pre-set~~ transceiver antenna polarization of each transceiver antenna is determined  
3 experimentally.

1 3. (Currently Amended) The wireless communication system of claim 2, wherein  
2 the ~~pre-set~~ transceiver antenna polarization of each transceiver antenna is experimentally  
3 determined by characterizing the separability of received data streams.

1 4. *Please cancel claim 4, without prejudice.*

1 5. (Original) The wireless communication system of claim 1, wherein each receiver  
2 antenna is spatially separate from at least one other receiver antenna, each receiver

3 antenna further comprising a receiver antenna polarization, at least one receiver antenna  
4 having a polarization that is different than at least one other receiver antenna.

1 6. (Currently Amended) The wireless communication system of claim 1, further  
2 comprising a receiver that is connected to the receiver antenna, the receiver including  
3 electronic circuitry for estimating ~~a~~ the channel matrix that represents ~~a~~ the transmission  
4 channel between the transceiver antennae and the receiver antennae, the ~~pre-set~~  
5 transceiver antenna polarization of each transceiver antenna being determined by  
6 ~~minimizing a~~ reducing the measure of the singular value spread of the channel matrix.

1 7. (Currently Amended) The wireless communication system of claim 5, wherein  
2 the receiver antenna polarization of each receiver antenna is ~~pre-set~~set to optimize  
3 separability of the received data streams.

1 8. (Currently Amended) The wireless communication system of claim 7, wherein  
2 the ~~pre-set~~ receiver antenna polarization of each receiver antenna is determined  
3 experimentally.

1 9. *Please cancel claim 9, without prejudice.*

1 10. (Original) The wireless communication system of claim 1, wherein the transceiver  
2 antenna polarization of each transceiver antenna is pre-set to minimize correlation  
3 between the data streams.

1    11. (Original) The wireless communication system of claim 10, wherein the pre-set  
2    transceiver antenna polarization of each transceiver antenna is determined  
3    experimentally.

1    12. (Original) The wireless communication system of claim 11, wherein a transmission  
2    channel between the transceiver antennae and the receiver antennae is estimated with a  
3    channel matrix, and wherein the pre-set transceiver antenna polarization of each  
4    transceiver antenna is experimentally determined by minimizing a correlation coefficient  
5    of the channel matrix.

1    13. (Original) The wireless communication system of claim 5, wherein the receiver  
2    antenna polarization of each receiver antenna is pre-set to minimize correlation between  
3    the data streams.

1    14. (Original) The wireless communication system of claim 13, wherein the pre-set  
2    receiver antenna polarization of each receiver antenna is determined experimentally.

1    15. (Original) The wireless communication system of claim 14, wherein a transmission  
2    channel between the transceiver antennae and the receiver antennae is estimated with a  
3    channel matrix, and wherein the pre-set receiver antenna polarization of each receiver  
4    antenna is experimentally determined by minimizing a correlation coefficient of the  
5    channel matrix.

1    16. (Original) The wireless communication system of claim 1, further comprising  
2    clusters of transceiver antennae, each cluster including a transmission channel, wherein  
3    the pre-set transceiver antenna polarization of each transceiver antenna is experimentally  
4    determined by minimizing co-channel interference between the clusters.

1    17. (Currently Amended)    A wireless communication system comprising:  
2                a plurality of spatially separate transceiver antennae to transmit a corresponding  
3                plurality of data streams comprising a communication channel to a remote receiver  
4                having a plurality of receiver antennae, each transceiver spatially separate from at least  
5                one other transceiver antenna, each transceiver antenna further comprising a transceiver  
6                antenna polarization, at least one transceiver antenna having a polarization that is  
7                different than at least one other transceiver antenna, each transceiver antenna transmitting  
8                a corresponding data stream;  
9                a plurality of receiver antennae, the receiver antennae receiving at least one data  
10          stream; wherein  
11              the communication channel between the transceiver antennae and the receiver  
12          antennae is characterized by a channel matrix, and wherein the transceiver antenna  
13          polarization of each transceiver antenna is adaptively set to optimize reduce a measure of  
14          singular value spread of the channel matrix separability of the received data streams base  
15          on channel parameters determined within a receiver connected to the receiver antennae.

1    18. (Currently Amended)    The wireless communication system of claim 17, wherein  
2    the receiver includes electronic circuitry for estimating a the channel matrix that represent  
3    a transmission channel between the transceiver antennae and the receiver antennae, the  
4    transceiver antenna polarization of each transceiver antenna being adaptively set by  
5    minimizing a the singular value spread of the channel matrix.

1    19. (Original) A method of wirelessly communicating between a transceiver and a  
2    receiver within a wireless communication system, the communication system comprising  
3    the transceiver, the transceiver comprising a plurality of transceiver antennae, each  
4    transceiver spatially separate from at least one other transceiver antenna, each transceiver  
5    antenna further comprising a transceiver antenna polarization, at least one transceiver  
6    antenna having a polarization that is different than at least one other transceiver antenna,  
7    the communication system further comprising the receiver, the receiver comprising a  
8    plurality of receiver antennae, the method comprising:  
9                 each transceiver antenna transmitting a corresponding data stream;  
10          the receiver antennae receiving at least one data stream;  
11                 electronic circuitry within the receiver estimating a channel matrix that represents  
12          a transmission channel between the transceiver antennae and the receiver antennae; and  
13                 pre-setting the transceiver antenna polarization of each transceiver antenna by  
14          minimizing a singular value spread of the channel matrix.

1    20. (Original) The method of wirelessly communicating between a transceiver and a  
2    receiver within a wireless communication system of claim 19, wherein each receiver

3 antenna is spatially separate from at least one other receiver antenna, each receiver  
4 antenna further comprising a receiver antenna polarization, at least one receiver antenna  
5 having a polarization that is different than at least one other receiver antenna, the method  
6 further comprising:

7 pre-setting the receiver antenna polarization of each receiver antenna by  
8 minimizing a singular value spread of the channel matrix.

1 21. (Original) The method of wirelessly communicating between a transceiver and a  
2 receiver within a wireless communication system of claim 19, the method comprising:  
3 pre-setting the transceiver antenna polarization of each transceiver antenna to  
4 minimize correlation between the data streams.

1 22. (Original) The method of wirelessly communicating between a transceiver and a  
2 receiver within a wireless communication system of claim 20, the method comprising:  
3 pre-setting the receiver antenna polarization of each receiver antenna to minimize  
4 correlation between the data streams.

1 23. (Currently Amended) A wireless communication system comprising:  
2 ~~a plurality of transceiver antennae, each transceiver spatially separate from at least~~  
3 ~~one other transceiver antenna, each transceiver antenna further comprising a transceiver~~  
4 ~~antenna polarization, at least one transceiver antenna having a polarization that is~~  
5 ~~different than at least one other transceiver antenna, each transceiver antenna transmitting~~  
6 ~~a corresponding data stream;~~

7        a plurality of a receiver, including one or more receiver antennae, the receiver  
8        antennae receiving at least one data stream from a remote transmitter having a plurality of  
9        transceiver antennae, at least one transceiver antenna having a polarization that is  
10      different from at least one other transceiver antenna, each transceiver antenna  
11      corresponding an associated data stream; and  
12        means for setting the transceiver antenna polarization of each transceiver antenna  
13        to reduce a measure of singular value spread of a channel matrix representation of a  
14        transmission channel including at least a subset of the data streams between the  
15        transceiver antennae and the one or more receiver antennae optimize separability of the  
16        received data streams.

1        24. *Please cancel claim 24 without prejudice.*

1        25. (Original) The wireless communication system of claim 23, wherein each receiver  
2        antenna is spatially separate from at least one other receiver antenna, each receiver  
3        antenna further comprising a receiver antenna polarization, at least one receiver antenna  
4        having a polarization that is different than at least one other receiver antenna.

1        26. (Currently Amended)     The wireless communication system of claim 23, further  
2        comprising a receiver that is connected to the receiver antennae, the receiver including  
3        electronic circuitry for estimating a to estimate the channel matrix that represents a the  
4        transmission channel between the transceiver antennae and the receiver antennae,  
5        wherein the means for setting the transceiver antenna polarization of each transceiver

6 antenna is responsive to the electronic circuitry minimizing a singular value spread of the  
7 channel matrix.

1 27. (Original) The wireless communication system of claim 25, further comprising  
2 means for setting the receiver antenna polarization of each receiver antenna to optimize  
3 separability of the received data streams.

1 28. (Original) The wireless communication system of claim 27, wherein a transmission  
2 channel between the transceiver antennae and the receiver antennae is estimated with a  
3 channel matrix, and wherein the means for setting the receiver antenna polarization of  
4 each receiver antenna comprises minimizing a singular value spread of the channel  
5 matrix.

1 29. (Original) The wireless communication system of claim 25, further comprising  
2 means for setting the receiver antenna polarization of each receiver antenna to optimize  
3 de-correlation of the received data streams.

1 30. (Original) The wireless communication system of claim 29, wherein a transmission  
2 channel between the transceiver antennae and the receiver antennae is estimated with a  
3 channel matrix, and wherein the means for setting the receiver antenna polarization of  
4 each receiver antenna comprises minimizing a correlation coefficient of the channel  
5 matrix.

1    31. *Please cancel claim 31 without prejudice.*

1    32. (New)    A wireless communication system of claim 23, wherein the means for setting the  
2    transceiver antennae polarization resides within the receiver.

1    33. (New)    A method comprising:

2    receiving a plurality of signals from a remote transmitter, the remote transmitter  
3    transmitting the plurality of signals from two or more transceiver antennae, wherein at least one  
4    transceiver antenna has a different polarization than another transceiver antenna;  
5    developing a channel matrix representation of a transmission channel that includes at  
6    least a subset of the plurality of received signals; and  
7    determining an improved polarization for at least a subset of the transceiver antennae to  
8    reduce a singular value spread in the developed channel matrix.